

CLAIMS

What is claimed is:

1. A fiber optic module for coupling photons between optoelectronic devices and optical fibers, the fiber optic module comprising:

a base having a first, a second, a third and a fourth opening;

a first vertical printed circuit board (PCB) arranged parallel to a first optical axis of a first optoelectronic device, the first optoelectronic device having terminals coupled to the first vertical printed circuit board, the first vertical printed circuit board arranged perpendicular to the base, the first vertical printed circuit board having a plurality of pins extending through the first opening in the base to couple to a system;

a second vertical printed circuit board (PCB) arranged parallel to a second optical axis of a second optoelectronic device, the second optoelectronic device having terminals coupled to the second vertical printed circuit board, the second vertical printed circuit board arranged perpendicular to the base, the second vertical printed circuit board having a plurality of pins extending through the second opening in the base to couple to the system;

a third vertical printed circuit board (PCB) arranged parallel to a third optical axis of a third optoelectronic device, the third optoelectronic device having terminals coupled to the third vertical printed circuit board, the third vertical printed circuit board arranged perpendicular to the base, the third vertical printed circuit board having a plurality of pins extending through the third opening in the

29 base to couple to the system;
30 a fourth vertical printed circuit board (PCB) arranged
31 parallel to a fourth optical axis of a fourth optoelectronic
32 device, the fourth optoelectronic device having terminals
33 coupled to the fourth vertical printed circuit board, the
34 fourth vertical printed circuit board arranged perpendicular
35 to the base, the fourth vertical printed circuit board having
36 a plurality of pins extending through the fourth opening in
37 the base to couple to the system; and
38 a shielded housing coupled to the base to encase the
39 first vertical, second vertical, third vertical, and fourth
40 vertical printed circuit boards to reduce electromagnetic
41 interference (EMI).

1 2. The fiber optic module of claim 1 further comprising:
2 an optical block coupled to the first, second, third and
3 fourth optoelectronic devices, the optical block having
4 a first, second, third and fourth openings to receive the
5 first, second, third and fourth optoelectronic devices
6 respectively, and
7 a first, second, third, and fourth lens to couple photons
8 between the first, second, third and fourth optoelectronic
9 devices and first, second, third and fourth optical fibers
10 respectively.

1 3. The fiber optic module of claim 2 further comprising:
2 a nose coupled to the base, the nose to receive an
3 optical fiber connector and to hold the first, second, third
4 and fourth optical fibers substantially fixed and aligned with
5 the first, second, third, and fourth optical openings of the
6 optical block.

1 4. The fiber optic module of claim 3 further comprising:

2 a nose shield surrounding the nose to reduce
3 electromagnetic interference.

1 5. The fiber optic module of claim 1 wherein,
2 the third vertical printed circuit board and the third
3 optoelectronic device and the fourth vertical printed circuit
4 board and the fourth optoelectronic device to provide
5 redundancy for the fiber optic module.

1 6. The fiber optic module of claim 1 wherein,
2 the first vertical printed circuit board and the first
3 optoelectronic device; the second vertical printed circuit
4 board and the second optoelectronic device; the third vertical
5 printed circuit board and the third optoelectronic device; and
6 the fourth vertical printed circuit board and the fourth
7 optoelectronic device to provide a four channel fiber optic
8 module.

1 7. A fiber optic module for coupling photons between
2 optoelectronic devices and optical fibers, the fiber optic
3 module comprising:

4 a base;

5 at least a pair of vertical printed circuit boards
6 arranged parallel to a first optical axis of a first
7 optoelectronic device and parallel to a second optical axis of
8 a second optoelectronic device respectively, the first
9 optoelectronic device having terminals coupled to one of the
10 vertical printed circuit boards and the second optoelectronic
11 device having terminals coupled to another one of the vertical
12 printed circuit boards, the at least pair of vertical printed
13 circuit boards being arranged perpendicular to the base;

14 at least a third printed circuit board (PCB) arranged
15 parallel to a third optical axis of a third optoelectronic

16 device, the third optoelectronic device having terminals
17 coupled to the third printed circuit board; and
18 at least a fourth printed circuit board (PCB) arranged
19 parallel to a fourth optical axis of a fourth optoelectronic
20 device, the fourth optoelectronic device having terminals
21 coupled to the fourth printed circuit board.

1 8. The fiber optic module of claim 7 further comprising:
2 a housing coupled to the base.

1 9. The fiber optic module of claim 8 wherein,
2 the housing is a shielded housing to encase the at least
3 pair of vertical printed circuit boards and the at least third
4 and the at least fourth printed circuit boards to reduce
5 electromagnetic interference (EMI).

1 10 The fiber optic module of claim 7 further comprising:
2 an optical block coupled to the first, second, third and
3 fourth optoelectronic devices, the optical block having
4 a first, second, third and fourth openings to receive the
5 first, second, third and fourth optoelectronic devices
6 respectively, and
7 a first, second, third, and fourth lens to couple photons
8 between the first, second, third and fourth optoelectronic
9 devices and first, second, third and fourth optical fibers
10 respectively.

1 11. A fiber optic module for coupling photons between
2 optoelectronic devices and optical fibers, the fiber optic
3 module comprising:
4 a base having a first, a second, a third and a fourth
5 opening;

6 a first horizontal printed circuit board (PCB) arranged
7 parallel to a first optical axis of a first optoelectronic
8 device, the first optoelectronic device having terminals
9 coupled to the first horizontal printed circuit board, the
10 first horizontal printed circuit board arranged parallel to
11 the base, the first horizontal printed circuit board having a
12 plurality of pins extending through the first opening in the
13 base to couple to a system;

14 a second horizontal printed circuit board (PCB) arranged
15 parallel to a second optical axis of a second optoelectronic
16 device, the second optoelectronic device having terminals
17 coupled to the second horizontal printed circuit board, the
18 second horizontal printed circuit board arranged parallel to
19 the base, the second horizontal printed circuit board having a
20 plurality of pins extending through the second opening in the
21 base to couple to the system;

22 a third horizontal printed circuit board (PCB) arranged
23 parallel to a third optical axis of a third optoelectronic
24 device, the third optoelectronic device having terminals
25 coupled to the third horizontal printed circuit board, the
26 third horizontal printed circuit board arranged parallel to
27 the base, the third horizontal printed circuit board having a
28 plurality of pins extending through the third opening in the
29 base to couple to the system;

30 a fourth horizontal printed circuit board (PCB) arranged
31 parallel to a fourth optical axis of a fourth optoelectronic
32 device, the fourth optoelectronic device having terminals
33 coupled to the fourth horizontal printed circuit board, the
34 fourth horizontal printed circuit board arranged parallel to
35 the base, the fourth horizontal printed circuit board having a
36 plurality of pins extending through the fourth opening in the
37 base to couple to the system; and

38 a shielded housing coupled to the base to encase the

39 first horizontal, second horizontal, third horizontal, and
40 fourth horizontal printed circuit boards to reduce
41 electromagnetic interference (EMI).

1 12 The fiber optic module of claim 11 further
2 comprising:

3 an optical block coupled to the first, second, third and
4 fourth optoelectronic devices, the optical block having

5 a first, second, third and fourth openings to receive the
6 first, second, third and fourth optoelectronic devices
7 respectively, and

8 a first, second, third, and fourth lens to couple photons
9 between the first, second, third and fourth optoelectronic
10 devices and first, second, third and fourth optical fibers
11 respectively.

1 13. The fiber optic module of claim 12 further
2 comprising:

3 a nose coupled to the base, the nose to receive an
4 optical fiber connector and to hold the first, second, third
5 and fourth optical fibers substantially fixed and aligned with
6 the first, second, third, and fourth optical openings of the
7 optical block.

1 14. The fiber optic module of claim 13 further
2 comprising:

3 a nose shield surrounding the nose to reduce
4 electromagnetic interference.

1 15. The fiber optic module of claim 11 wherein,
2 the third horizontal printed circuit board and the third
3 optoelectronic device and the fourth horizontal printed

4 circuit board and the fourth optoelectronic device to provide
5 redundancy for the fiber optic module.

1 16. The fiber optic module of claim 11 wherein,
2 the first horizontal printed circuit board and the first
3 optoelectronic device; the second horizontal printed circuit
4 board and the second optoelectronic device; the third
5 horizontal printed circuit board and the third optoelectronic
6 device; and the fourth horizontal printed circuit board and
7 the fourth optoelectronic device to provide a four channel
8 fiber optic module.

1 17. A fiber optic module for coupling photons between
2 optoelectronic devices and optical fibers, the fiber optic
3 module comprising:

4 a base having a first, a second, a third and a fourth
5 opening;

6 a first vertical printed circuit board (PCB) arranged
7 parallel to a first optical axis of a first optoelectronic
8 device, the first optoelectronic device having terminals
9 coupled to the first vertical printed circuit board, the first
10 vertical printed circuit board arranged perpendicular to the
11 base, the first vertical printed circuit board having a
12 plurality of pins extending through the first opening in the
13 base to couple to a system;

14 a second vertical printed circuit board (PCB) arranged
15 parallel to a second optical axis of a second optoelectronic
16 device, the second optoelectronic device having terminals
17 coupled to the second vertical printed circuit board, the
18 second vertical printed circuit board arranged perpendicular
19 to the base, the second vertical printed circuit board having
20 a plurality of pins extending through the second opening in
21 the base to couple to the system;

FIG. 10

22 a third horizontal printed circuit board (PCB) arranged
23 parallel to a third optical axis of a third optoelectronic
24 device, the third optoelectronic device having terminals
25 coupled to the third horizontal printed circuit board, the
26 third horizontal printed circuit board arranged parallel to
27 the base, the third horizontal printed circuit board having a
28 plurality of pins extending through the third opening in the
29 base to couple to the system;

30 a fourth horizontal printed circuit board (PCB) arranged
31 parallel to a fourth optical axis of a fourth optoelectronic
32 device, the fourth optoelectronic device having terminals
33 coupled to the fourth horizontal printed circuit board, the
34 fourth horizontal printed circuit board arranged parallel to
35 the base, the fourth horizontal printed circuit board having a
36 plurality of pins extending through the fourth opening in the
37 base to couple to the system; and

38 a shielded housing coupled to the base to encase the
39 first vertical, second vertical, third horizontal, and fourth
40 horizontal printed circuit boards to reduce electromagnetic
41 interference (EMI).

1 18 The fiber optic module of claim 17 further
2 comprising:

3 an optical block coupled to the first, second, third and
4 fourth optoelectronic devices, the optical block having

5 a first, second, third and fourth openings to receive the
6 first, second, third and fourth optoelectronic devices
7 respectively, and

8 a first, second, third, and fourth lens to couple photons
9 between the first, second, third and fourth optoelectronic
10 devices and first, second, third and fourth optical fibers
11 respectively.

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a base having a first, a second, and a third opening;
a first vertical printed circuit board (PCB) arranged parallel to a first optical axis of a first optoelectronic device, the first optoelectronic device having terminals coupled to the first vertical printed circuit board, the first vertical printed circuit board arranged perpendicular to the base, the first vertical printed circuit board having a plurality of pins extending through the first opening in the base to couple to a system;

a second vertical printed circuit board (PCB) arranged parallel to a second optical axis of a second optoelectronic device, the second optoelectronic device having terminals coupled to the second vertical printed circuit board, the second vertical printed circuit board arranged perpendicular to the base, the second vertical printed circuit board having a plurality of pins extending through the second opening in the base to couple to the system;

a third horizontal printed circuit board (PCB) arranged parallel to a third optical axis of a third optoelectronic device and a fourth optical axis of a fourth optoelectronic device, the third and fourth optoelectronic devices each having terminals coupled to the third horizontal printed circuit board, the third horizontal printed circuit board arranged parallel to the base, the third horizontal printed circuit board having a plurality of pins extending through the third opening in the base to couple to the system; and

a shielded housing coupled to the base to encase the first vertical, second vertical, and third horizontal printed circuit boards to reduce electromagnetic interference (EMI).

24. The fiber optic module of claim 23 further comprising:

an optical block coupled to the first, second, third and

4 fourth optoelectronic devices, the optical block having
5 a first, second, third and fourth openings to receive the
6 first, second, third and fourth optoelectronic devices
7 respectively, and

8 a first, second, third, and fourth lens to couple photons
9 between the first, second, third and fourth optoelectronic
10 devices and first, second, third and fourth optical fibers
11 respectively.

1 25. The fiber optic module of claim 24 further
2 comprising:

3 a nose coupled to the base, the nose to receive an
4 optical fiber connector and to hold the first, second, third
5 and fourth optical fibers substantially fixed and aligned with
6 the first, second, third, and fourth optical openings of the
7 optical block.

1 26. The fiber optic module of claim 25 further
2 comprising:

3 a nose shield surrounding the nose to reduce
4 electromagnetic interference.

1 27. The fiber optic module of claim 24 wherein,
2 the second vertical printed circuit board and the second
3 optoelectronic device and the fourth optoelectronic device to
4 provide redundancy for the fiber optic module.

1 28. The fiber optic module of claim 24 wherein,
2 the first vertical printed circuit board and the first
3 optoelectronic device; the second vertical printed circuit
4 board and the second optoelectronic device; and the third
5 horizontal printed circuit board and the third optoelectronic

6 device and the fourth optoelectronic device to provide a four
7 channel fiber optic module.

1 29. A fiber optic module for coupling photons between
2 optoelectronic devices and optical fibers, the fiber optic
3 module comprising:

4 a base having a first, a second, a third and a fourth
5 opening;

6 a first vertical printed circuit board (PCB) arranged
7 parallel to a first optical axis of a first optoelectronic
8 device, the first optoelectronic device having terminals
9 coupled to the first vertical printed circuit board, the first
10 vertical printed circuit board arranged perpendicular to the
11 base, the first vertical printed circuit board having a
12 plurality of pins extending through the first opening in the
13 base to couple to a system;

14 a second vertical printed circuit board (PCB) arranged
15 parallel to a second optical axis of a second optoelectronic
16 device, the second optoelectronic device having terminals
17 coupled to the second vertical printed circuit board, the
18 second vertical printed circuit board arranged perpendicular
19 to the base, the second vertical printed circuit board having
20 a plurality of pins extending through the second opening in
21 the base to couple to the system;

22 a third vertical printed circuit board (PCB) arranged
23 parallel to a third optical axis of a third optoelectronic
24 device, the third optoelectronic device having terminals
25 coupled to the third vertical printed circuit board, the third
26 vertical printed circuit board arranged perpendicular to the
27 base, the third vertical printed circuit board having a
28 plurality of pins extending through the third opening in the
29 base to couple to the system;

30 a fourth horizontal printed circuit board (PCB) arranged

31 parallel to a fourth optical axis of a fourth optoelectronic
32 device, the fourth optoelectronic device having terminals
33 coupled to the fourth horizontal printed circuit board, the
34 fourth horizontal printed circuit board arranged parallel to
35 the base, the fourth horizontal printed circuit board having a
36 plurality of pins extending through the fourth opening in the
37 base to couple to the system; and

38 a shielded housing coupled to the base to encase the
39 first vertical, second vertical, third vertical, and fourth
40 horizontal printed circuit boards to reduce electromagnetic
41 interference (EMI).

1 30. The fiber optic module of claim 29 further
2 comprising:

3 an optical block coupled to the first, second, third and
4 fourth optoelectronic devices, the optical block having

5 a first, second, third and fourth openings to receive the
6 first, second, third and fourth optoelectronic devices
7 respectively, and

8 a first, second, third, and fourth lens to couple photons
9 between the first, second, third and fourth optoelectronic
10 devices and first, second, third and fourth optical fibers
11 respectively.

1 31. The fiber optic module of claim 30 further
2 comprising:

3 a nose coupled to the base, the nose to receive an
4 optical fiber connector and to hold the first, second, third
5 and fourth optical fibers substantially fixed and aligned with
6 the first, second, third, and fourth optical openings of the
7 optical block.

1 32. The fiber optic module of claim 31 further

2 comprising:

3 a nose shield surrounding the nose to reduce
4 electromagnetic interference.

1 33. The fiber optic module of claim 29 wherein,
2 the second vertical printed circuit board and the second
3 optoelectronic device and the fourth horizontal printed
4 circuit board and the fourth optoelectronic device to provide
5 redundancy for the fiber optic module.

1 34. The fiber optic module of claim 29 wherein,
2 the first vertical printed circuit board and the first
3 optoelectronic device; the second vertical printed circuit
4 board and the second optoelectronic device; the third vertical
5 printed circuit board and the third optoelectronic device; and
6 the fourth horizontal printed circuit board and the fourth
7 optoelectronic device to provide a four channel fiber optic
8 module.

1 35. A fiber optic module for coupling photons between
2 optoelectronic devices and optical fibers, the fiber optic
3 module comprising:

4 a base;

5 at least a pair of vertical printed circuit boards
6 arranged parallel to a first optical axis of a first
7 optoelectronic device and parallel to a second optical axis of
8 a second optoelectronic device respectively, the first
9 optoelectronic device having terminals coupled to one of the
10 vertical printed circuit boards and the second optoelectronic
11 device having terminals coupled to another one of the vertical
12 printed circuit boards, the at least pair of vertical printed
13 circuit boards being arranged perpendicular to the base and
14 having a first and second electrical connectors to plug into

15 and out of an electrical connector of a host printed circuit
16 board;

17 at least a third printed circuit board (PCB) arranged
18 parallel to a third optical axis of a third optoelectronic
19 device, the third optoelectronic device having terminals
20 coupled to the at least third printed circuit board, the at
21 least third printed circuit board having a third electrical
22 connector to plug into and out of an electrical connector of
23 the host printed circuit board; and

24 at least a fourth printed circuit board (PCB) arranged
25 parallel to a fourth optical axis of a fourth optoelectronic
26 device, the fourth optoelectronic device having terminals
27 coupled to the fourth printed circuit board, the at least
28 fourth printed circuit board having a fourth electrical
29 connector to plug into and out of an electrical connector of
30 the host printed circuit board.

1 36. The fiber optic module of claim 35 further
2 comprising:

3 a housing coupled to the base.

1 37. The fiber optic module of claim 36 wherein,
2 the housing is a shielded housing to encase the at least
3 pair of vertical printed circuit boards and the at least third
4 and the at least fourth printed circuit boards to reduce
5 electromagnetic interference (EMI).

1 38 The fiber optic module of claim 35 further
2 comprising:

3 an optical block coupled to the first, second, third and
4 fourth optoelectronic devices, the optical block having

5 a first, second, third and fourth openings to receive the
6 first, second, third and fourth optoelectronic devices

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